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Experimental Determinations of Frictional Constitutive Parameters for Serpentine Mud from South Chamorro Seamount

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Brace and Byerlee [1] suggested that stick slip instabilities in laboratory friction experiments were analogous to earthquake rupture. Since then, a number of experiments were performed, and Dietrich [2] and Ruina [3] proposed frictional constitutive laws of the slip rate and state variable type. Complex frictional behaviors (e.g. memory effect and history dependence) were successfully modeled by incorporation of state variables.

Although extrapolation of the experimental results to the nature has a problem of difference in scales in dimension of faults (length and width), parameters in these constitutive relations are of great importance to model the fault behavior. Tullis and Weeks [4] and Reinen and Weeks [5] described a method to obtain the specific values of the parameters by fitting the experimental data for velocity step tests accounting for the elastic deformation of the apparatus. In this study, low slip rate frictional experiments have been performed using serpentine mud from South Chamorro seamount (ODP Leg 195 Site 1200) on the Mariana forearc. The data for velocity steps have been fit using slowness law and elastic deformation of the apparatus to obtain the specific values of the parameters.

The absolute value of frictional coefficient is around 0.2 which is very low and consistent with frictional experiments of pure chrysotile [6]. A peak on a velocity step disappears in the velocity steps between 0.0154 μm/s and 0.1554 μm/s. a, and Σb can not be defined there. At higher slip rates, a does not change, but b increases with increasing slip rate. a-Σb is positive at slip rates less than 1 μm/s and becomes negative at slip rate higher than 10 μm/s. d_c values can not be defined at slip rate less than 0.1 μm/s, and increase with increasing slip rates at the higher slip rates. Positive a-Σb at low slip rate may explain the aseismicity of the Mariana subduction zone

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